Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of Revision of Part 15 of the FCC's Rules Regarding Ultra-wideband Transmission Systems	ET Docket 98-153

Ex Parte Comments of Time Domain Corporation

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August 16, 2001

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Reductions Below Part 15 Class B Are Unwarranted

The FCC has proposed a 12 dB reduction below Part 15 Class B levels below 2 GHz and has further asked if this reduction is needed below 2 GHz or if it should be applied only to emissions in the restricted bands below 2 GHz.[1] This paper summarizes Time Domain's views on the issue of GPS sensitivity to spectral lines within ultra-wideband emissions and their relationship to a general limit for emissions within the GPS bands.

This 12 dB reduction is not warranted because no filing in this proceeding has demonstrated that noise-like UWB emissions at Part 15 Class B levels cause harmful interference even to the most demanding safety-of-life applications such as GPS and SARSAT in real world scenarios. All of the analyses and test results presented in this proceeding were based on a UWB power level of –41.3 dBm/MHz (the general limit). Further, the analyses presented in this proceeding related to interference to safety-of-life applications were based on static models. By static it is meant that the spatial relationship between the UWB source and the victim receiver was fixed as contrasted with dynamic models where the

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[1] The NPRM proposes that emissions at 2GHz be reduced 12 dB below the general Part 15 limits. Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, Notice of Proposed Rulemaking, ET Docket 98-153 (rel. May 11, 2000) ("NPRM"), ¶39.

spatial relationship between the UWB source and the victim receiver is constantly changing as would be the case for GPS systems and the safety-of-life services evaluated by the NTIA.[2] TIME DOMAIN has shown that when incorporating real world factors affecting the path loss between the UWB source and the various victim receivers, the protection criteria for the non-GPS safety-of-life services are met.[3] Moreover, since JHUAPL found that at ranges beyond 3 meters, GPS receivers returned to nominal performance, no credible scenario has been proposed to suggest how UWB emissions at the general limits would endanger safety-of-life applications.[4]

TIME DOMAIN recognizes the particular concern the Commission has for GPS and that out of that concern the Commission may set a power spectral density limit in the GPS band below the general Part 15 limit. TIME DOMAIN, while maintaining no such reduction is warranted based on the record in this

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[2] Jones et al, "Assessment of Compatibility between Ultra-wideband (UWB) Systems and Global Positioning System (GPS) Receivers", NTIA Special Publication 01-45, February 2001.

[3] Comments of Time Domain Corporation, ET Docket 98-153, February 23, 2001 and Reply Comments of Time Domain Corporation, ET Docket 98-153, March 12, 2001.

[4] Final Report, UWB-GPS Compatibility Analysis Report, Strategic Systems Department, Applied Research Laboratory, Johns Hopkins University, March 8, 2001 (revised April 24,2001).

proceeding, urges the Commission to limit any such reduction to only the GPS bands.

Stanford has shown – using a static model for the special case of a non-noise-like UWB emitter with a specific pulse repetition frequency (PRF) selection – a spectral feature associated with that UWB emission may need to be attenuated by as much as 10 dB below the broadband noise level of the UWB emission[5]. (However, this finding was a result of a highly contrived experiment. The UWB signal source used by Stanford did not incorporate any methodology for data modulation or creating separately identifiable transmission channels – factors that would have significantly reduced the spectral features of their UWB signal source.) Adoption by the Commission of a 12dB reduction in the power spectral density limit for the GPS band affords the protection recommended by Stanford for this scenario.

<u>The FCC Must Continue to Defend Part 15 Class B Levels</u>

The FCC, through numerous proceedings, has defended the Part 15 Class B level[6] and has further rejected arguments that GPS systems require protection at

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[5] Luo et al, "Potential Interference to GPS from UWB Transmitters", Stanford University, March 16, 2001, pps 30 – 31. Submitted to the record by the NTIA on March 20, 2001

[6] FCC Third Memorandum Opinion and Order and Third Report and Order, In the Matter of The Development of Operational, Technical and Spectrum

levels below the current Part 15 Class B levels for broadband emissions.[7] Reducing the limits for UWB will lead to a continued stream of pleadings from existing users of the spectrum for the same degree of protection each time the Commission proposes to permit a new service or new technology. Reducing the limits for UWB by 12 dB also puts the Commission in the curious position of imposing reduced limits for UWB transmitter emissions while permitting the digital device portion of a composite device that is coupled with a UWB transmitter to radiate at levels potentially more than 20 dB higher at the same frequency.[8] Moreover, local oscillator emissions or emissions from circuitry associated with generating the local oscillator emission from receivers, including

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Requirements For Meeting Federal, State and Local Public Safety Agency Communication Requirements Through the Year 2010, WT Docket 96-86, release October 10, 2000, ¶76; FCC, AirTouch Satellite Services US, Inc. Application for Blanket Authorization to Construct and Operate up to 500,000 Mobile Satellite Earth Terminals Through the GLOBALSTAR Mobile Satellite System File Application No. 1367-DSE-P/L-97; and FCC First Report and Order In the Matter of Service Rules for the 746 – 764 and 776 – 794 MHz Bands, and Revisions to Part 27 of the Commission’s Rules, released January 7, 2000, ¶115.

[7] 47 CFR §25.213(b).

[8] 12 dB + 10 dB = 22 dB; 12 dB from the NPRM and an additional 10 dB as recommended by Stanford.

a UWB receiver, would not be subject to a specific emissions limit if the receiver is designed to operate above 960 MHz.[9]

To further stress the lack of a need for stringent emissions limits in the GPS bands, TIME DOMAIN obtained copies of test data for several certified Part 15 transmitters. It appears that the existing certified Part 15 transmitters would not meet the proposed 12 dB down limit for broadband noise-like emissions in the GPS band, much less a more stringent requirement for spectral features. Attachment A contains a few excerpts of data sheets from test reports contained in certification filings for remote keyless entry devices. As can be seen these devices have spectral features in restricted bands (GPS) at levels greater than those proposed for UWB devices.[10] Attachment B contains measurements Time Domain conducted to confirm the existence of spectral lines in the L1 GPS band at levels above those being considered by the FCC for UWB devices.

(Clearly, if GPS is as sensitive as the GPS community claims, then any safety-of-life applications must consider the existence of these devices, as there are probably tens of millions of them. One can imagine that in an airport parking lot a large number of these could be in use at any given time not to mention the super-regenerative receiver in each vehicle that is operating continuously. One can

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[9] 47 CFR Part §15.109

[10] While these features appear to be "spurious emissions," their characterization does not change their impact, or lack thereof.

also imagine that passengers aboard aircraft could easily trigger these devices accidentally.)

GPS Spectral Line Sensitivity

Recent *ex parte* filings[11] have discussed rules to constrain spectral line characteristics of UWB emissions across the GPS L1 band. These filings have proposed emissions levels lower than proposed in the Notice of Proposed Rulemaking based on measurements in narrower resolution bandwidths than specified for Part 15 Class B digital device certification. The stated purpose of these reductions is to protect GPS. The source of this concern seems to be that GPS receivers are more sensitive to in-band CW emissions than to white-noise emissions with equivalent power. Two studies submitted to the UWB NPRM record deal with this sensitivity directly:

The Stanford Study. The Stanford study intentionally selected a specific PRF for the purpose of creating a CW signal that fell on a GPS C/A code line at 1575.260 MHz. The CW signal was substituted for a white Gaussian noise signal whose RMS power in the GPS 24 MHz receiver bandpass was 13.8 dB above the RMS power level that would be measured in a 1 MHz bandwidth. Since the CW signal used by Stanford would have the same measured RMS power level in both a 1

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[11] For example, US GPS Industry Council Ex Parte filing Docket ET 98-153 dated June 21, 2001 and XtremeSpectrum Ex Parte filings Docket ET 98-153 dated April 25, 2001, April 26, 2001 and May 30, 2001.

MHz bandwidth and a 24 MHz bandwidth, we can compare its interference potential to that of the white Gaussian noise signal used by Stanford as measured in a 1 MHz bandwidth. This allows for interference potential comparison for both emission characteristics using the same measurement bandwidth as proposed to be used in the NPRM. Stanford claimed the CW signal produced interference degradation at a level that was 17 dB below the level of white gaussian noise measured in a 24 MHz bandwidth that produced an equivalent degradation. Therefore, to maintain equality of degradation that would be produced by a spectral feature (CW component of a UWB noise-like emission) when compared to a 1 MHz bandwidth measurement of the broadband characteristic of the UWB noise-like emission, the spectral feature component of the UWB emission must be suppressed 3.2 dB below the specified limit for the noise-like emission (*i.e.*, 13.8dB – 17dB = -3.2 dB). Thus, the Stanford result suggests that a GPS receiver will react to a CW signal just as it will react to a broadband noise source with 3.2 dB more power when both are measured across a 1 MHz resolution bandwidth[12]. Stanford then explains that the GPS spectral line at 1575.365 MHz is 6.5 dB more sensitive than the one at 1575.260 MHz. Thus, if they had generated a spectral line at 1575.365 MHz the argument

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[12] "If the broadband noise power is measured at the output of a 1 MHz bandpass filter (as in more traditional GPS interference study), then equal damage comes from a UWB signal that is approximately 3.2 dB weaker which must be qualified by the PRN characteristics under test." Luo, p. 30.

asserts 6.5 dB + 3.2 dB = 9.7 dB[13] more degradation of the GPS receiver with respect to this signal. Of course, to quantify this degradation, one would have to carefully contrive a scheme to maintain the synchronization between the GPS spectral line for worst case interference and a CW or CW spectral component of a UWB signal as noted below. One should recognize that due to the dynamic relationships that will always exist between GPS receivers, GPS satellites, and any potential UWB source, a scenario representative of such a contrived scheme could never exist under actual usage conditions.

The NTIA GPS Report. The NTIA, in their study, states "[t]he GPS C/A-code receiver showed approximately 10 dB less sensitivity to these noise-like UWB signals as compared to those UWB signals deemed as CW-like." [14] It should be noted that this conclusion is based on UWB signals with discrete spectral lines (coherent emission structure) where the UWB source used a synchronized generation technique where "spectral alignment was guaranteed" between the

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[13] Luo, p. 30.

[14] Jones et al, "Assessment of Compatibility between Ultra-wideband (UWB) Systems and Global Positioning System (GPS) Receivers", NTIA Special Publication 01-45, p *viii*.

GPS spectral lines and the UWB spectral lines.[15] Thus, like the Stanford study, the NTIA experiment created an unrealistic situation.

An Additional Limit is Not Necessary

While Time Domain does not dispute the additional sensitivity of GPS receivers to in-band CW emissions, Time Domain does question the rationale for an additional limit meant to constrain spectral characteristics. The 19.94 MHz PRF UWB signal generator used by Stanford does not resemble any useful UWB device. Useful UWB communication systems must have a mechanism for selecting the intended recipient of a transmission (a form of "channelization") and modulating data onto the transmitted signal. These factors ensure that UWB communication devices will have noise-like emissions. For example, time dithering pseudo-noise codes reduce spectral features by randomizing the transmitted signal. The process of data modulation on top of the pseudo-noise code or channelization coding further randomizes the signal resulting in an additional reduction of spectral features. (Transmitted data tend to be random, otherwise, there is not much need to transmit it. This variability will cause variations in spectral properties.) As an example, if a UWB radar application

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[15] Hoffman, J. *et al*, Measurements to Determine Potential Interference to GPS Receivers from Ultrawideband Transmission Systems, February 2001 NTIA Report 01-384, February 2001, p 4-8

required additional units in any one area a “channelization” technique such as a noise code would allow each unit to identify its emission and at the same time make its signals noise-like. Further, high pulse rate radars require noise coding to eliminate target range ambiguities. In short, even if noise coding were not needed for channelization, its use would still be desirable.

Limits Must be Based on Analysis That Considers Real-world Factors

Unlike the testing regimes that have been submitted to the UWB NPRM record, in the real-world, UWB emitters will have random orientations, will not all be continuously transmitting (*e.g.*, if one UWB communication transceiver is transmitting, at least one UWB transceiver must be listening), and will be used in and around cluttered environments. These real-world factors will ensure that GPS receivers and other systems are exposed to significantly less power than was used during these tests.

If the FCC perceives that an additional limit is required, then Time Domain proposes that the adjustment for spectral lines in the GPS bands be 3 dB, and certainly no more than 10 dB relative to a power level of –41.3 dBm/MHz EIRP (the general limit). Any reduction greater than 3 dB should only be applicable to PRF’s that generate spectral lines near the most sensitive GPS spectral lines, when measured across a 10 kHz bandwidth, since the Stanford study suggests that only in the worst-case is 10 dB necessary, but that 3 dB is more typical. Time Domain reiterates its previously stated position that based on the record in this proceeding no additional reduction for spectral features has been shown to be needed if the Commission reduces the general limit in the GPS band by 12 dB.

Again, Time Domain would also like to call to the attention of the Commission Appendices A and B attached to this document. Additionally, as a matter of curiosity, Time Domain conducted two preliminary spectral scans of ambient signals in the Radionavigation bands below 2 GHz. The available data from those scans was used to generate power spectral density charts of the ambient signals at two locations. These scans, contained in Attachment C, clearly show that there are significant existing sources – probably much greater than Part 15 Class B levels – of RF noise in the Radionavigation bands. These appendices provide some insight into existing emissions and, therefore, guidance as to appropriate limits for future emissions from developing technologies.

A Limit Below Part 15 Class B Sets a Bad Precedent

The Commission will not be considering UWB rules against a blank slate. Many emissions limits already provide for noise that falls into the GPS band to be no lower than limits that are slightly greater than the Part 15 general limits. Future spectrum initiatives for new licensed services will, no doubt, need to consider the GPS band limits. An overly restrictive limit runs the risk of unnecessarily limiting UWB technology and denying the public the benefits of UWB. Similarly, overly restrictive limits also make it hard for the Commission to develop limits for new generations of equipment that will support advanced communications services that will not be UWB technology but will emit emissions that will produce broadband out-of-band emissions. As such, the emissions limits adopted in this proceeding and the justifications for adopting those limits could surface again as the Commission grapples with Third Generation Wireless and other spectrum demands.

Respectfully,
Time Domain Corporation

By: s/Paul Withington
Paul Withington
Vice President

August 16, 2001

Attachment A:
Certification Filings for Several Remote Keyless Entry Key Fobs

These files clearly show emissions in both the L1 and L5 GPS bands at levels greater than those under consideration by the FCC by the FCC for UWB devices. There are approximately 1800 certifications for garage door opener and security and remote control transmitters of the type represented by these data files. Most, if not all, of these transmitters have associated with them super-regenerative receivers producing broadband noise emissions (as much as 20 to 30 MHz broad) at the fundamental and harmonics (harmonics of these receivers have the same spectral characteristics as the fundamental frequency) of the tuned receiver frequency. When activated by the associated transmitter, these receivers produce broadband noise emissions with spectral features whose amplitude is somewhat higher than the noise-like component. These receivers are active 24 hours a day, 7 days a week and are present in large numbers around airports in parking lots and residential housing near those airports.

Report of Measurements
Applications for control,security alarm,door opener or remote switch

Description: 390 MHz transmitter Code Hopping

DATE: 01/28/2000
ITEM TESTED: GT-30 Code Hopping Transmitter Unit No. 1
MANUFACTURER: Linear Corporation
TRADE NAME:
PRODUCT ID: EF4 ACP00743

DISTANCE AT WHICH MEASURED: 3 meters, DUT 1 meter above ground
REFERENCE: 15.231(a,b,c)
MEASUREMENT PROCEDURE: IEEE-Intentional Radiators C63.4-1991

RADIATION: per 15.205

Tuned Freq. MHz	Emission Frequenc MHz	Ambient Level dBm	FCC Limit dBm	Meter Reading dBm	Antenna Factor dB	Cable Loss dB	Amp Gain dB	Dist Fac Factor dB	Duty Cycle dB	Field Strength dBm/mtr	dBuV/mt	uV/M	FCC Limit uV/M	dB:FCC	Freq. MHz
390.00	390.00	-94.80	-12.95	-16.5	22.1	1.4	27.3	0.00	11.0	-31.30	75.70	6095.37	9170.00	-3.55	390.00
	780.00	-87.40	-40.33	-43.7	27.8	2.0	26.2	0.00	11.0	-51.10	55.90	623.73	919.00	-3.37	780.00
	1170.	-82.90	-44.83	-51.1	26.3	2.6	20.8	0.00	11.0	-54.00	53.00	446.68	919.00	-6.27	1170.00
	1560	-79.60	-48.13	-54.3	28.5	3.0	20.1	0.00	11.0	-53.90	53.10	451.86	919.00	-6.17	1560.00
	1950.	-76.20	-51.53	-53.6	30.2	3.4	18.8	0.00	11.0	-49.80	57.20	724.44	919.00	-2.07	1950.00
	2340	-81.74 *	-45.99 *	#N/A	31.5	3.8	16.5	9.54	11.0	#N/A	#N/A	#N/A	919.00	#N/A	2340.00
	2730	-82.84 *	-53.39 *	#N/A	32.5	4.2	10.5	9.54	11.0	#N/A	#N/A	#N/A	919.00	#N/A	2730.00
	3120	-81.84 *	-64.89 *	#N/A	33.3	4.4	0.0	9.54	11.0	#N/A	#N/A	#N/A	919.00	#N/A	3120.00
	3510	-80.64 *	-66.09 *	#N/A	34.2	4.7	0.0	9.54	11.0	#N/A	#N/A	#N/A	919.00	#N/A	3510.00
	3900	-79.74 *	-66.99 *	#N/A	34.8	5.0	0.0	9.54	11.0	#N/A	#N/A	#N/A	919.00	#N/A	3900.00

The spectrum was searched from 25 MHz to 4 GHz
No other emissions were observed except those shown on this page.

* NOTE: 1 meter measurement corrected to 3 meters

15.107(d) Conducted Emissions Not Applicable- Battery Powered

ENGINEER

Jan 28, 2000
DATE

SUMMARY OF TEST RESULTS
IN ACCORD WITH FCC RULES PART 15 AND C63.4-1992

Equipment Model:	ACP00870
Transmitter Tested to C63.4-1992 Section:	FCC Rules 15.231
Field Strength at a distance of 3 meters:	8900 uV/Mtr (- 0.5 dB below limit) @ 390 MHz
Peak to Average Ratio:	11 dB - Worst Case Duty Cycle
Test Conditions:	Radiated (Sections 11 & 13)
Transmitter: Transmitter Frequency:	390 MHz Nominal (Factory Tuned Only)
Bandwidth (20 dB down)	< 0.010% of Center Freq.
Frequency Tolerance:	N/A (Nominal +/- 0.125 MHz)
Frequency Stability:	N/A (Nominal +/- 0.125 MHz)
Transmitter Spurious at 3 meters: (Worst Harmonic)	841 uV/Mtr (- 0.75 dB below limit)
Frequency:	1170 MHz
Momentary Operation (Yes/No)	Yes
Holdover time after manual release:	0 seconds
Duration of transmission after activation:	45 seconds on any single manual activation

Attestation:

The radio apparatus identified in the application has been subject to all the applicable test conditions specified in FCC Rules Part 15 and all of the requirements of the Standard have been met.

Regulatory Compliance Engineer

John W. Kuivinen, P.E. John W. Kuivinen Date: Jan. 31, 2000

LINEAR CORPORATION
FCC ID: EF4 ACP00870

From Certification Filing for:
TRW Chrysler RS Transmitter Model GQ43VT18R
Dated April 20, 1999

Table 5.1 Highest Emissions Measured

Radiated Emission - RF											TRW Chrysler RS TX; FCC/IC
#	Freq. MHz	Ant. Used	Ant. Pol.	Pr dBm	Det. Used	Ka dB/m	Kg dB	E3* dBμV/m	E3lim dBμV/m	Pass dB	Comments
1	315.0	Dip	H	-25.1	Pk	18.9	21.8	65.8	75.6	9.8	flat *worst case
2	315.0	Dip	V	-27.1	Pk	18.9	21.8	63.8	75.6	11.8	end
3	630.0	Dip	H	-54.4	Pk	25.2	18.5	46.2	55.6	9.4	flat
4	630.0	Dip	V	-54.8	Pk	25.2	18.5	45.8	55.6	9.8	end
5	945.0	Dip	H	-68.7	Pk	28.9	16.1	37.9	55.6	17.7	flat
6	945.0	Dip	V	-68.9	Pk	28.9	16.1	37.7	55.6	17.9	end
7	1260.0	Horn	H	-34.3	Pk	20.4	28.1	51.8	55.6	3.8	flat
8	1575.0	Horn	H	-42.1	Pk	21.4	28.2	44.9	54.0	9.1	side
9	1890.0	Horn	H	-33.3	Pk	22.1	28.1	54.5	55.6	1.1	flat
10	2205.0	Horn	H	-42.3	Pk	22.9	27.0	47.4	54.0	6.6	flat
11	2520.0	Horn	H	-42.0	Pk	24.0	26.6	49.2	55.6	6.4	flat
12	2835.0	Horn	H	-55.0	Pk	24.9	25.4	38.3	55.6	17.3	flat
13	3150.0	Horn	H	-55.7	Pk	25.2	24.8	38.5	55.6	17.1	end
14											
15											
16			All transmitter orientations were measured; above are the major emissions.								
17											
18			*includes -13.2 dB duty factor								
17											

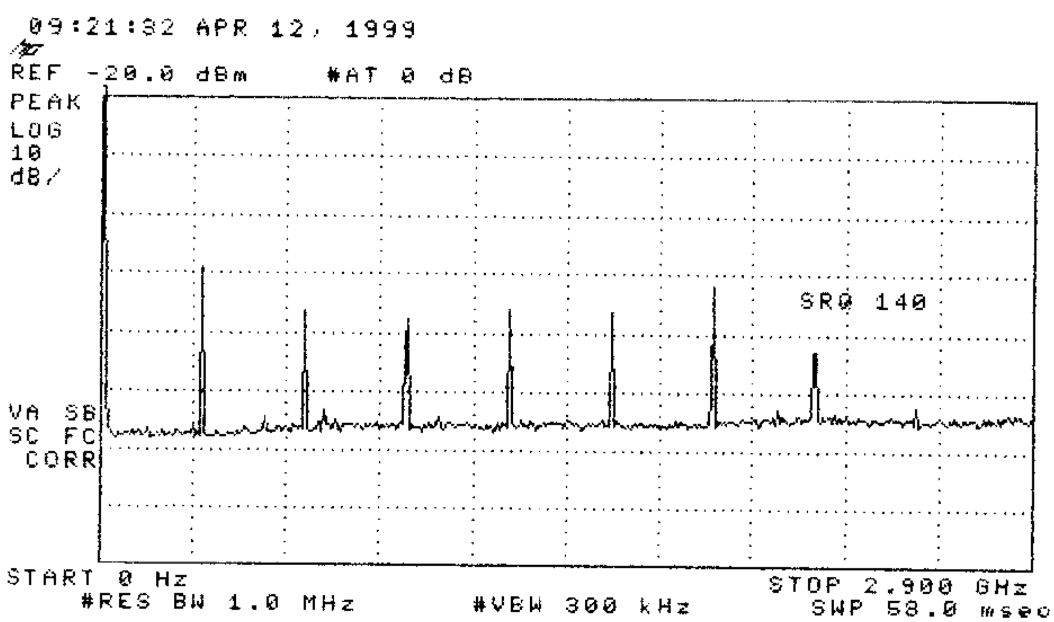

Table 1

FCC 15.231 3M Radiated Emissions Data – Site 2

CLIENT: Connaught Electronics Ltd.
FCC ID: LQN1821
DATE: 12/9/99
BY: Herb Meadows
JOB #: 5553X

FREQ MHz	POL H/V	Azimuth Degree	Ant Height m	SA LEVEL (QP) dBuV	Correction Factor dB	AFc dB/m	E-FIELD dBuV/m	E-FIELD uV/m	LIMIT uV/m	MRGN dB
315.00	H	180.00	1.0	55.9	-13.9	16.5	58.5	840.2	6041.7	-17.1
315.00	V	90.00	1.0	39.7	-13.9	16.5	42.3	130.1	6041.7	-33.3
630.00	H	0.00	1.0	36.9	-13.9	24.1	47.1	226.8	604.2	-8.5
630.00	V	90.00	1.0	22.4	-13.9	24.1	32.6	42.7	604.2	-23.0
945.00	H	180.00	1.0	27.0	-13.9	28.8	41.9	124.5	604.2	-13.7
945.00	V	90.00	1.0	17.0	-13.9	28.8	31.9	39.4	604.2	-23.7

Average Measurements Above 1 GHz:

FREQ MHz	POL H/V	Azimuth Degree	Ant Height m	SA LEVEL (PEAK) dBuV	AFd dB/m	AFc dB/m	E-FIELD dBuV/m	E-FIELD uV/m	LIMIT uV/m	MRGN dB
1260.00	H	225.00	1.0	62.6	-13.9	-10.6	38.1	80.4	604.2	-17.5
1260.00	V	90.00	1.0	57.3	-13.9	-10.6	32.8	43.7	604.2	-22.8
1575.00	H	90.00	1.0	71.7	-13.9	-8.5	49.3	291.7	500.0	-4.7
1575.00	V	0.00	1.0	70.3	-13.9	-8.5	47.9	248.3	500.0	-6.1
1890.30	H	270.00	1.0	63.4	-13.9	-6.7	42.8	138.0	604.2	-12.8
1890.30	V	225.00	1.0	58.2	-13.9	-6.7	37.6	75.9	604.2	-18.0
2205.30	V	270.00	1.0	58.3	-13.9	-5.7	38.7	86.1	500.0	-15.3
2205.30	H	270.00	1.0	66.2	-13.9	-5.7	46.6	213.8	500.0	-7.4
2520.20	V	225.00	1.0	53.1	-13.9	-5.2	34.0	50.1	500.0	-20.0
2520.20	H	180.00	1.0	61.0	-13.9	-5.2	41.9	124.5	500.0	-12.1
2835.20	V	225.00	1.0	62.4	-13.9	-4.7	43.8	154.9	500.0	-10.2
2835.20	H	270.00	1.0	60.3	-13.9	-4.7	41.7	121.6	500.0	-12.3
3150.40	V	225.00	1.0	67.3	-13.9	-4.3	49.1	285.1	604.2	-6.5
3150.40	H	135.00	1.0	70.5	-13.9	-4.3	52.3	412.1	604.2	-3.3

Attachment B:
Remote Keyless Entry Measurement Summary

This document summarizes the results of some preliminary spectral measurements of remote keyless entry devices (fob) for automobiles. The test was performed with a Rohde & Schwarz FSEM 30 spectrum analyzer using a peak detector function.

The test setup for these measurements is shown below in Figure B- 1. It should be noted that the test setup does not conform to an OATS site, however, based on absorption by the hand[16] and other factors influencing measured levels made at 1 meter, it would be expected that measured levels on an OATS site would be anywhere from 4 dB to 10 dB higher than the levels reported here. Initially, the Electro-Metrics RGA-30 antenna (200 MHz – 2 GHz) was used as the receive horn as it was believed that the remote keyless entry device transmitted in about the 200 – 300 MHz range. The antenna was connected directly to the spectrum analyzer (no LNA) and the device under test was held by a person at about waist level 1 meter from the antenna.[17]

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[16] See OET Bulletin 19 for adjustment of measured field strength for handheld devices.

[17] An actual compliance measurement facility would utilize a metallic ground plane and a non-conductive fixture to hold the key fob at a one meter height with

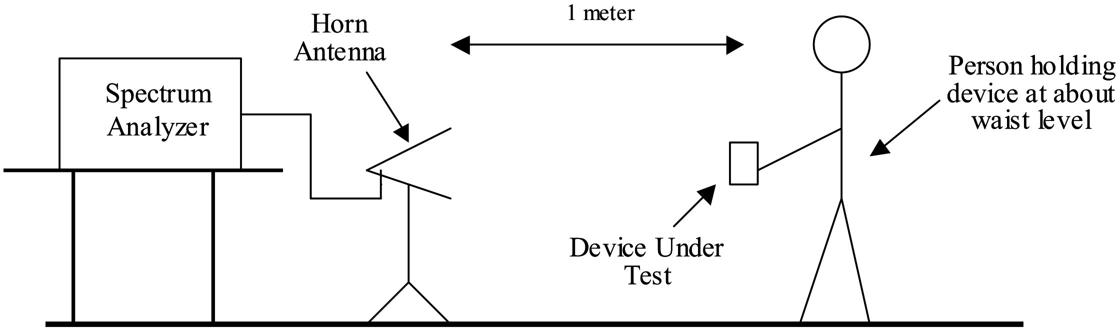

Figure B- 1. A sketch of the test setup.

The spectrum analyzer scan shown in Figure B- 1 shows one of the scans taken in this initial test. There are multiple signals in the range from about 400 to 900 MHZ; however, the main emission from the device under test was clearly seen in the scan to be located at approximately 315 MHz. This makes sense as the FCC allows Part 15 garage door openers and remote keyless entry systems in the 225 – 328.6 MHz frequency range. In addition to the main spike located at ~315 MHz an additional spike located at 1.575 GHz also appeared when the device was activated. It is hypothesized that this spike is the 5th harmonic of the 315 MHz signal.

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a separation distance of 3 meters between the device and the antenna. Thus, these measurements are not exactly what a compliance laboratory would find.

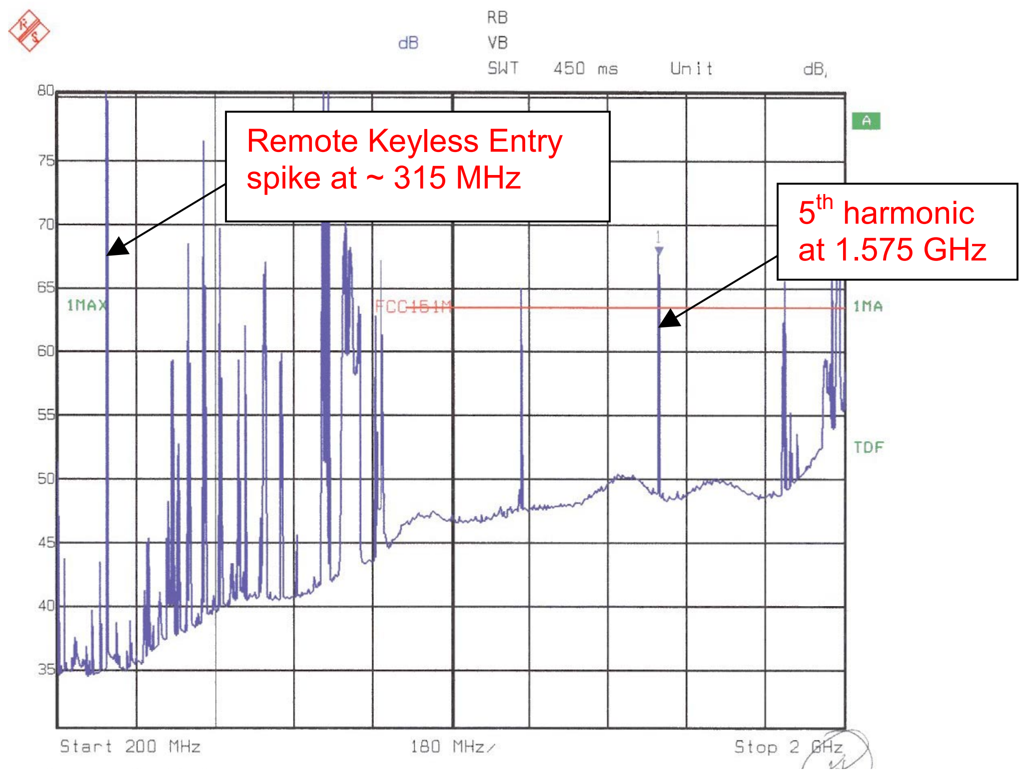

Figure B- 2. Measurement made with Electro Metrics RGA-30 horn (200 MHz – 2 GHz)

To get an idea of the relative strength of the spike at 1.575 GHz, the FCC Part 15 Class B limit for unintentional radiators when interpolated for a 1 meter measurement distance is also shown in this and subsequent scans. As can be seen, the spike located at 1.575 GHz is higher than this line. The measurement shown in Figure B- 2, however, cannot be considered precise, as the antenna factors for the RGA-30 horn were not entered into the spectrum analyzer for this measurement.

The experiment was then repeated with a compliance test configuration for emissions above 1 GHz. To do this, the RGA-30 horn was replaced with the

EMCO 3115 horn (1 – 18 GHz) and the proper 1-meter antenna factors were entered into the spectrum analyzer for this antenna.

Figure B- 3 show the ambient signal levels for reference. Figures B-4 through B-7 show the spectra of several different remote keyless entry devices. The FCC Part 15 Class B limit for unintentional radiators interpolated for 1 meter is again shown for reference.

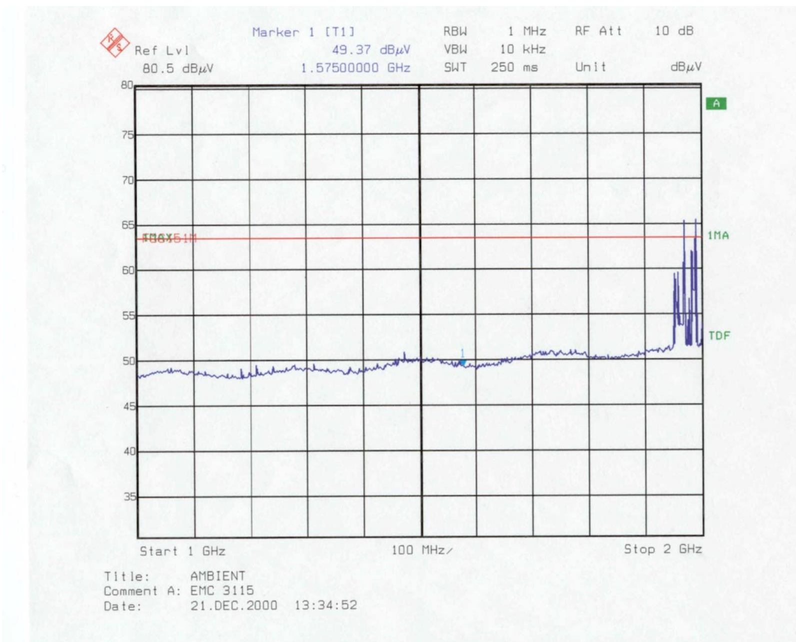

Figure B- 3. Ambient Scan.

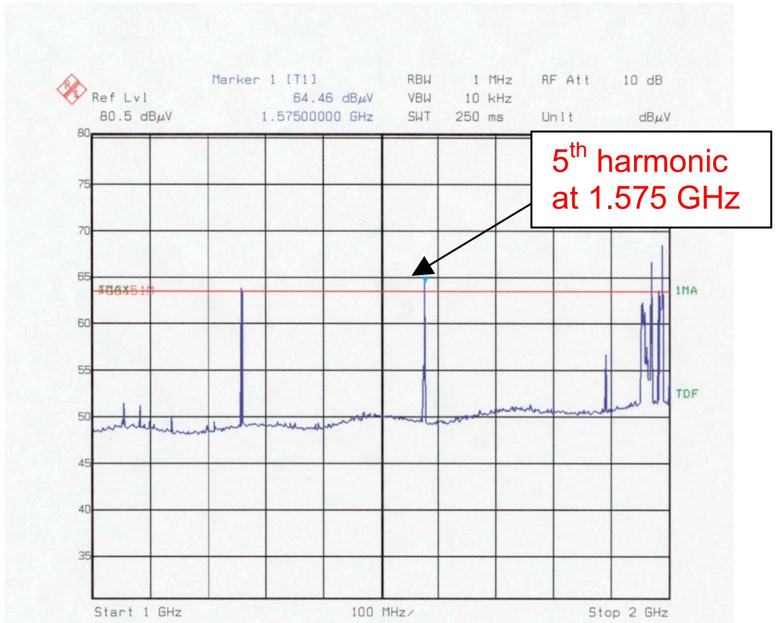

Figure B- 4. 2000 Ford Explorer Fob (64.46 dBµV @ 1.575 GHz)

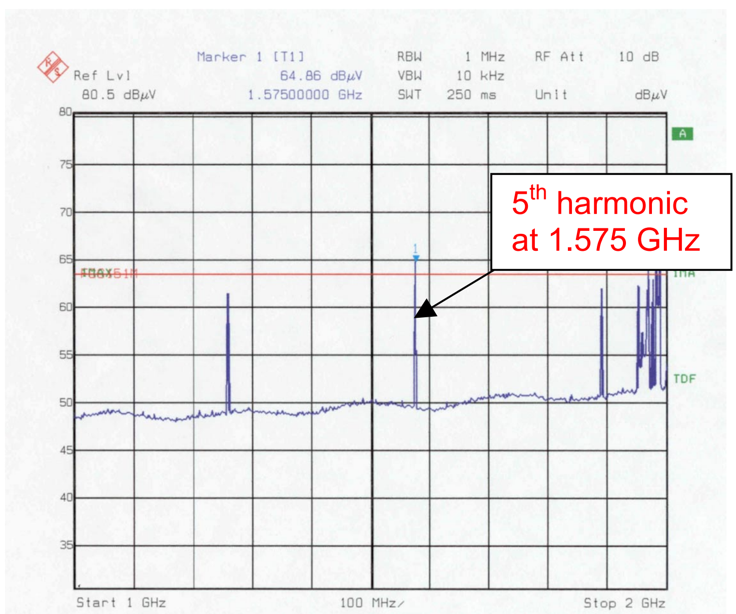

Figure B- 5. 1998 Ford Expedition Fob (64.86 dBµV @ 1.575 GHz)

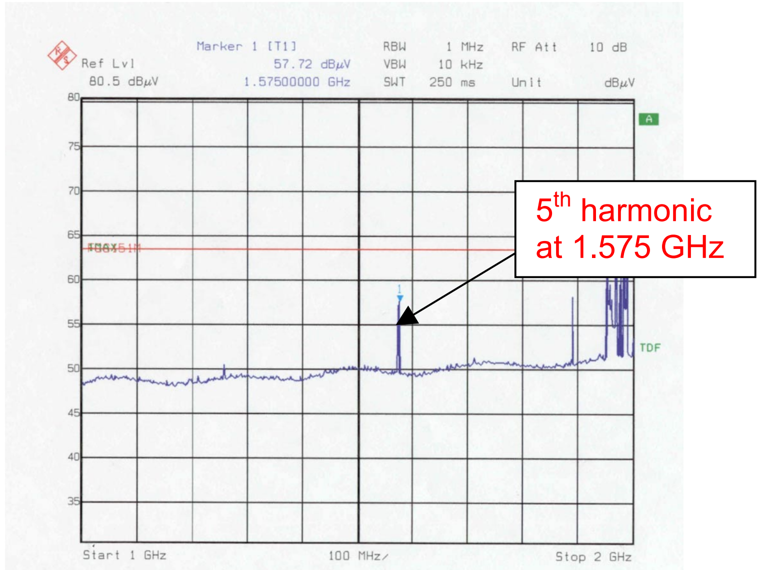

Figure B- 6. 1997 Jeep Cherokee Fob (57.72 dBµV @ 1.575 GHz)

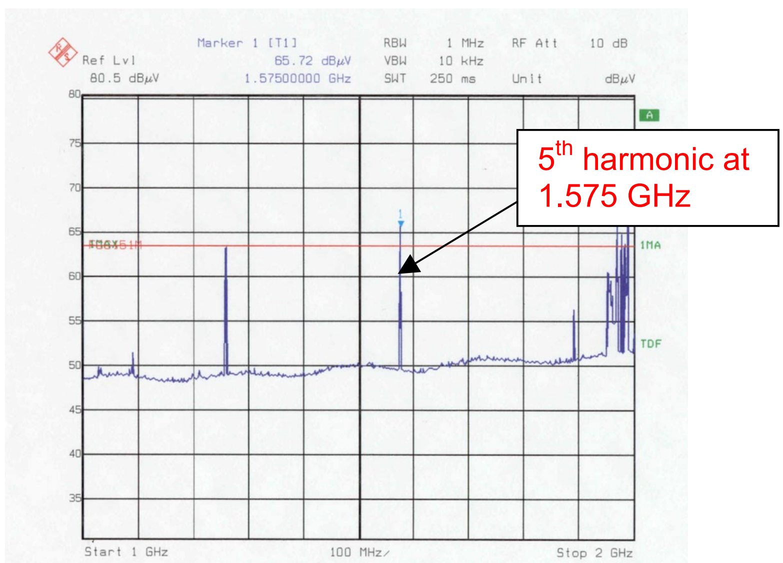

Figure B- 7. 2001 Honda Accord Fob (65.72 dBµV @ 1.575 GHz)

Attachment C:
Power Spectral Density Measurements of Radionavigation Bands in Baltimore and Washington, DC Areas

As a matter of curiosity, TIME DOMAIN did two preliminary scans of ambient signals in the Radionavigation bands below 2 GHz. The available data from those scans was used to generate power spectral density charts of the ambient signals at two locations. These charts are made available in this proceeding in order to provide interested parties with what is potentially useful insight as to real world conditions that all radio systems typically deal with on a daily basis.

This data shows the GPS bands are not pristine, but rather subject to random emissions from existing unknown RF sources. Table C - 1 shows the field strengths at the two measurement locations where the data was taken. It should be noted that the levels in Table C-1 reflect the incident field strength on the measurement antenna.

In order to place this data in context of a UWB device generating 500 μV/m at 3 meters, one can take the aforementioned UWB device and extrapolate the field strength at various distances. Thus, at 30 meters, the emission level from the UWB device is 50 μV/m and at 300 meters the UWB device emission level is 5 μV/m. At the Baltimore site the measured maximum ambient levels are well above the level produced by the UWB device at a distance of 30 meters and for the Washington site the measured ambient levels are above the level produced by the UWB device at a distance of 30 meters.

For the measured ambient data presented, the nearest facility that could have been a potential source of the emissions was approximately 300 to 500 meters distance. It is obvious that the ambient levels at distances as close as 3 meters to the source of these ambient emissions are likely to be much higher than 500 μV/m.

Table C - 1: Estimated Maximum Field Strength Levels at Locales

Radionavigation Band	Baltimore Inner Harbor Commercial District	Washington, DC – Washington Hospital Center
L1	80 μV/M	35 μV/M
L2	150 μV/M	25 μV/M
L5	560 μV/M	800 μV/M

Baltimore Inner Harbor Commercial Area

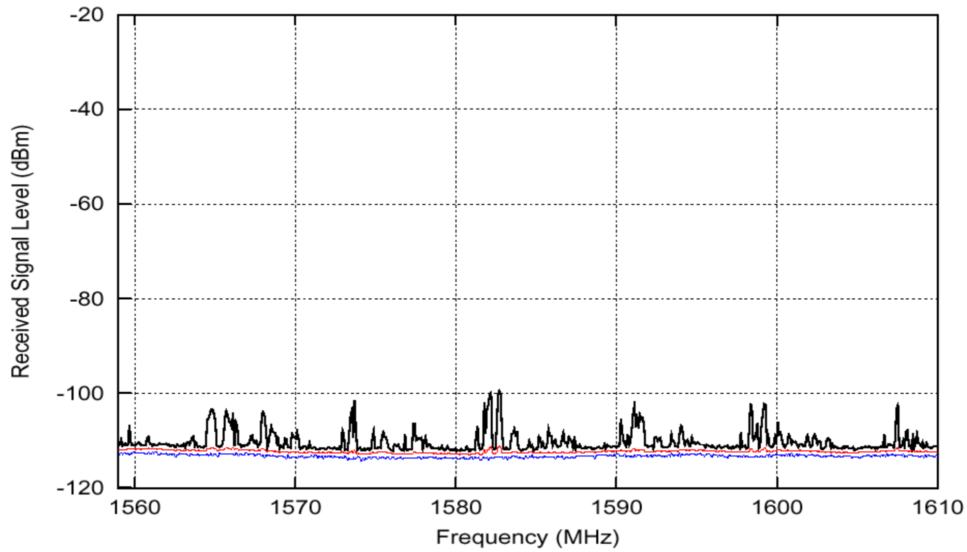

Figure C- 1. GPS L1 Band measured with 10 kHz resolution bandwidth and average detector.

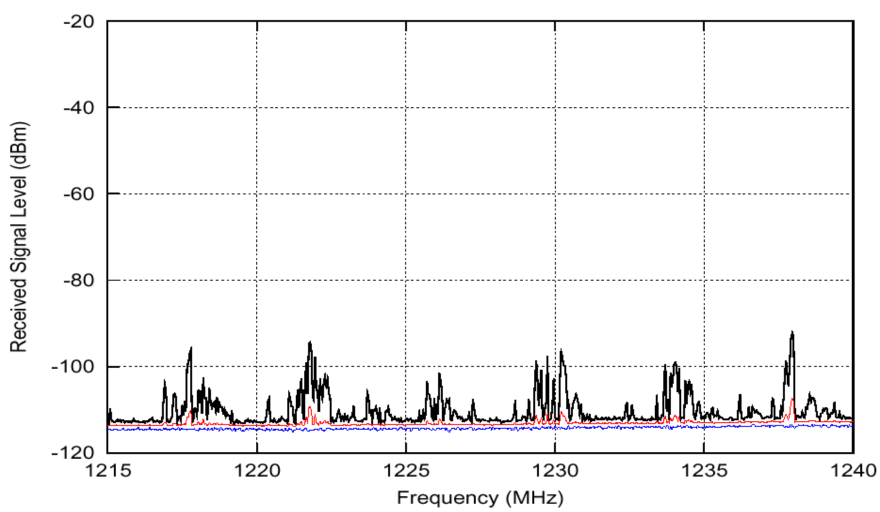

Figure C- 2. GPS L2 Band measured with 10 kHz resolution bandwidth and average detector.

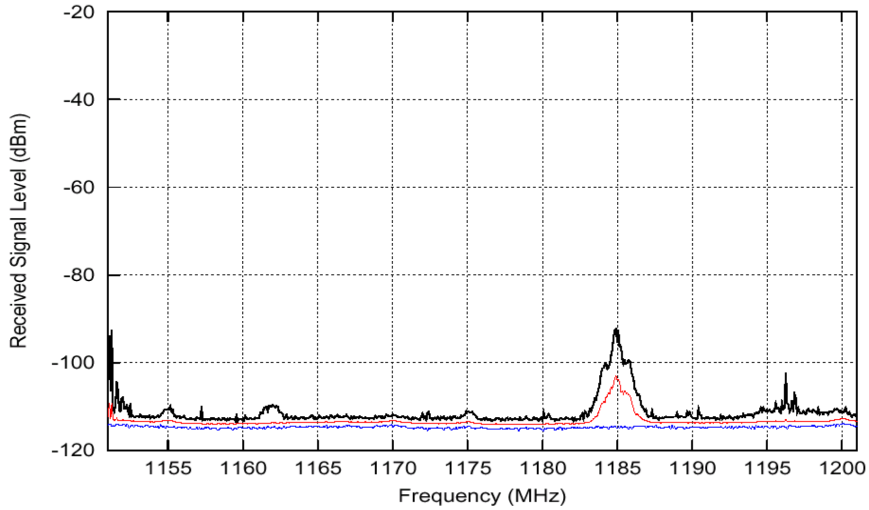

Figure C- 3. GPS L5 Band measured with 10 kHz resolution bandwidth and average detector.

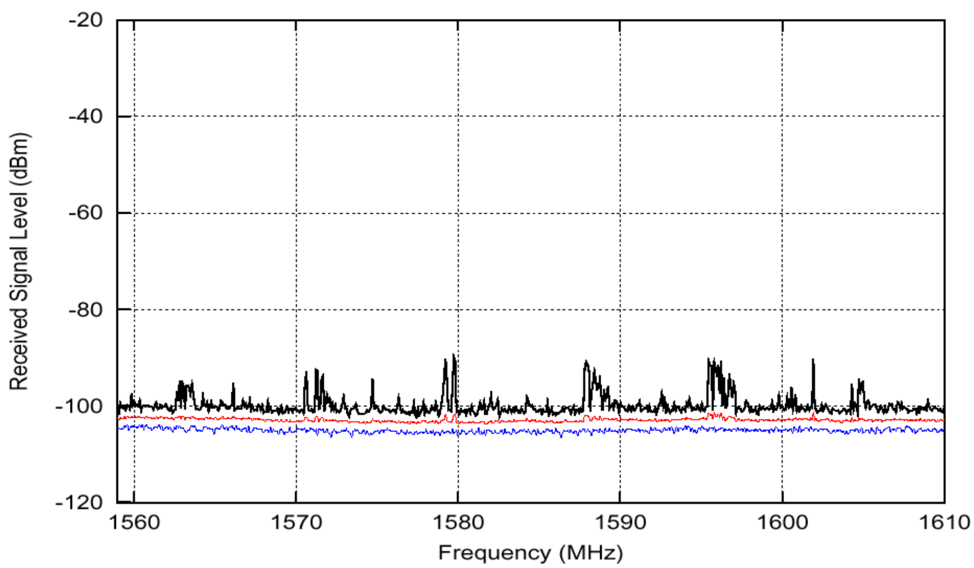

Figure C- 4. GPS L1 Band measured with 1 MHz resolution bandwidth and peak detector.

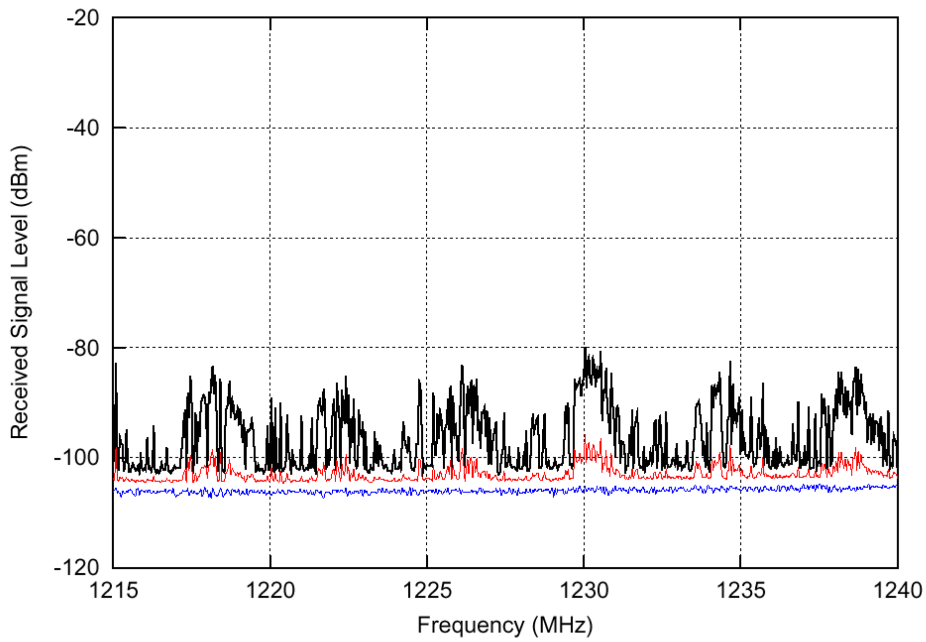

Figure C- 5. GPS L2 Band measured with 1 MHz resolution bandwidth and peak detector.

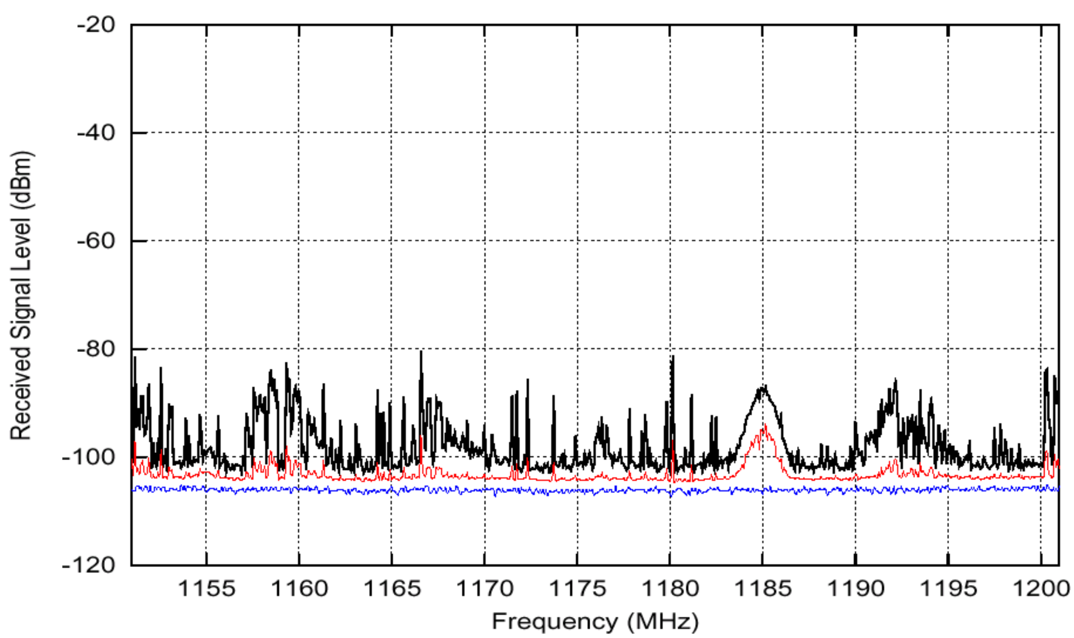

Figure C- 6. GPS L5 Band measured with 1 MHz resolution bandwidth and peak detector.

Washington Hospital Center

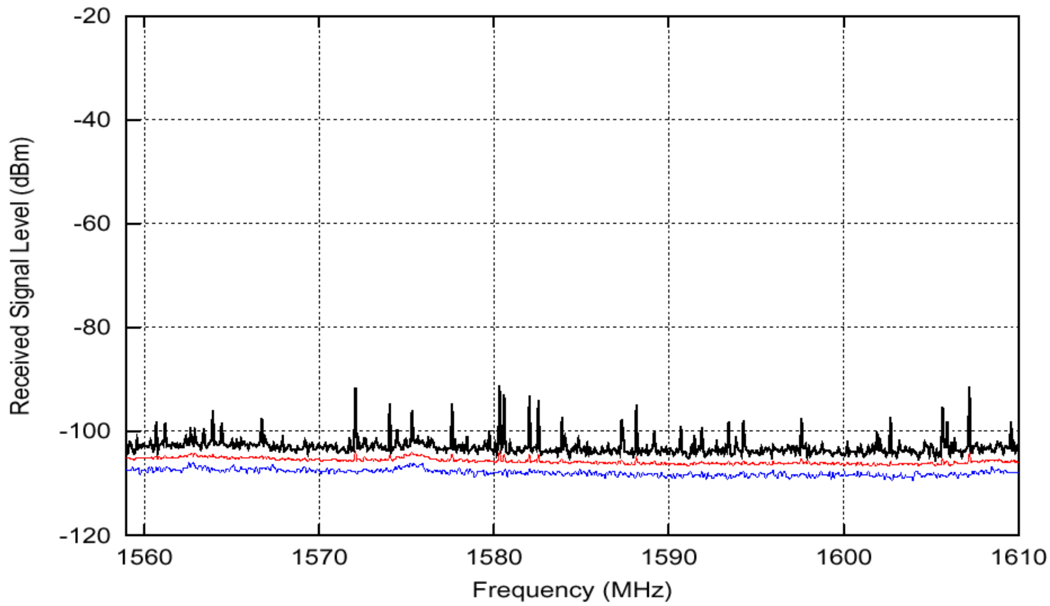

Figure C- 7. GPS L1 Band measured with 1 MHz resolution bandwidth and peak detector.

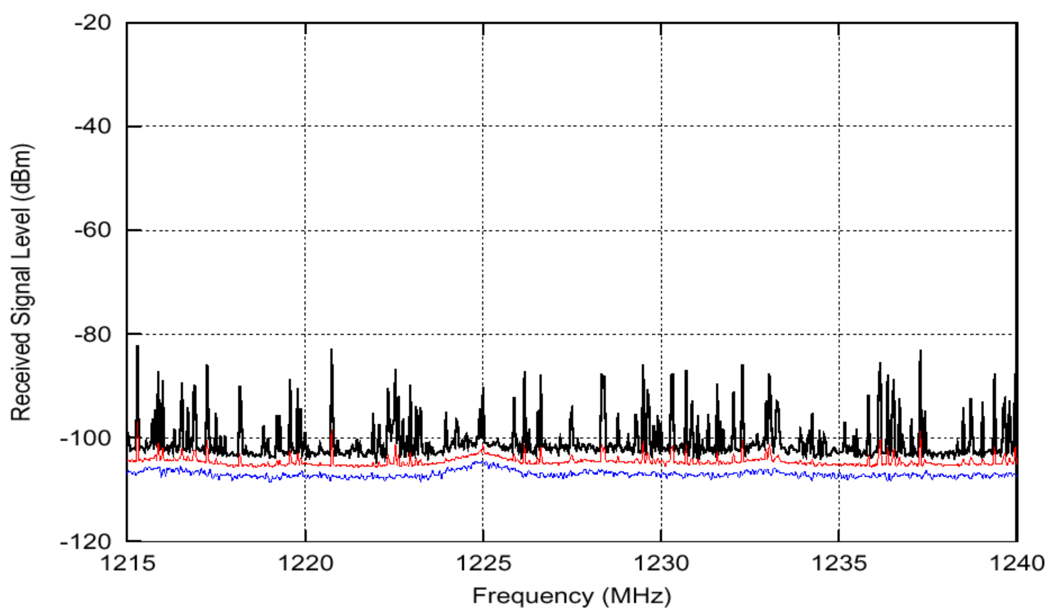

Figure C- 8. GPS L2 Band measured with 1 MHz resolution bandwidth and peak detector.

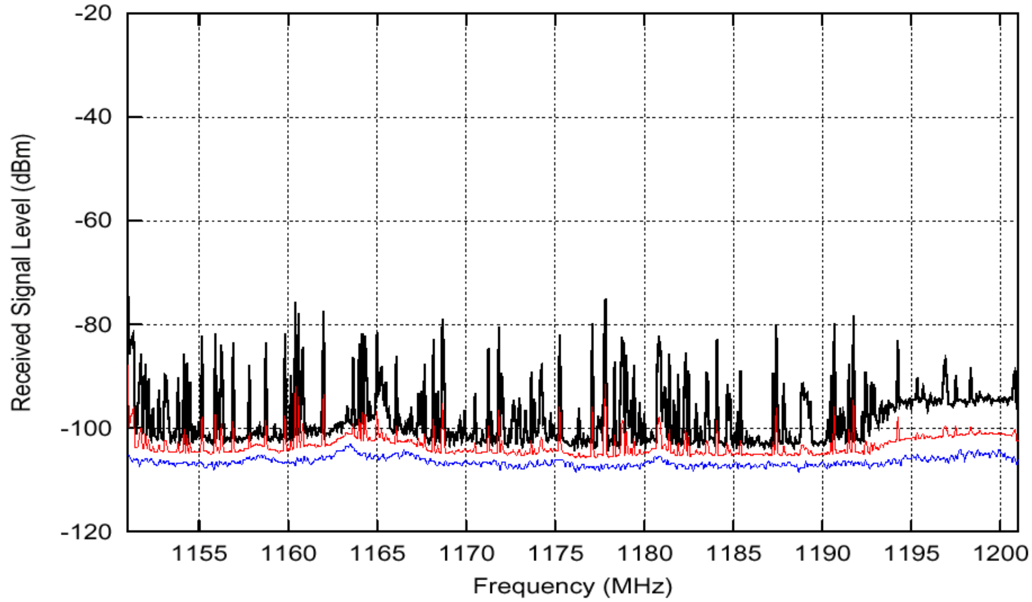

Figure C- 9. GPS L5 Band measured with 1 MHz resolution bandwidth and peak detector.